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Short Period Aliasing Effects of Atmospheric Mass Variations on Satellite Gravity Mission Data

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Coming satellite gravity missions such as GRACE and/or GOCE will be expected to provide tremendously high accuracy gravity field data, which can be used even for temporal gravity changes due to surface mass redistribution. For many scientific purposes, a time series of spherical harmonic coefficients (Stokes coefficients) in a proper span will be employed, because, due to the nature of the orbital sampling, it is impossible to obtain high spatial and temporal resolution simultaneously. For instance, the GRACE achieves relatively high spatial resolution in every two to three months. During this period temporal mass variations occur, which may not be observable. However, this variability may alias into longer period variations and affect the gravity field estimation process.

On the other hand, as the level-1 products, the GOCE will provide along track gravity gradients and the GRACE will provide along track range rate data. Both of these along track data sets will be expected to give us interesting information for the studies of short period gravity variations, even though they will be affected the short period gravity effects of the atmosphere directly. Although the atmospheric effects can be calculated using an operational analysis data, there still remain several problems such as data interpolation and the response of the ocean (IB or NIB) especially in high frequencies. We thus mainly discuss the aliasing effects and some issues using the along track data sets by a simulation of the level-1 data set.

Outline of the simulation are as followed. At first, we determined the location of the satellite for every data sampling, i.e. for every 10 seconds. Subsequently, with a special attention of the IB and/or NIB processes, the corresponding geoid height variation ('measurements') was calculated using ECMWF operational analysis data for every satellite location at every time span. After collecting a suitable duration of 'measurements', the differences of the 'measured' and the averaged 'real' signal was determined. Subsequently short period aliasing effect was determined as a spatial mean of the sampled aliasing errors for all possible duration within a year. The results show that the short-period aliasing of the atmospheric effects is a major error source for seasonal signal recovery, and the improvement of the long-wavelength seasonal geoid recovery by GRACE-FO (SSI) against the GRACE would be negligible, unless the aliasing effects are appropriately removed.